CLAIMS

1. An integrated photoacoustic spectroscopy cell, comprising:

a multi-layer structure having an inner layer disposed between top and bottom outer layers, with the inner layer being patterned to form a resonant cavity; and

a thin-film, membrane microphone formed on one of the outer layers and acoustically coupled to the resonant cavity.

2. The integrated photoacoustic spectroscopy cell according to claim 1, wherein the resonant cavity is an open-tube resonant cavity to receive light from a source.

3. The integrated photoacoustic spectroscopy cell according to claim 1, wherein at least the inner layer is patterned to include buffer cavities on either side of the resonant cavity.

4. The integrated photoacoustic spectroscopy cell according to claim 3, wherein one or both of the top and bottom outer layers are patterned to include buffer cavities aligned with the buffer cavities in the inner layer on either side of the resonant cavity.

5. The integrated photoacoustic spectroscopy cell according to claim 3, further including gas inlet and outlet ports through one or both of the outer layers and into the buffer cavities.

6. The integrated photoacoustic spectroscopy cell according to claim 1, wherein the thin-film microphone is a piezoelectric microphone.

7. The integrated photoacoustic spectroscopy cell according to claim 1, wherein the microphone is acoustically coupled to the resonant cavity through an acoustic port in communication with the resonant cavity.

8. The integrated photoacoustic spectroscopy cell according to claim 1, wherein the layers are silicon wafers.

9. An integrated photoacoustic spectroscopy cell, comprising:

a structure including an inner layer sandwiched between top and bottom outer layers;

the inner layer being patterned to include an open-tube resonant cavity and buffer cavities on either side thereof;

one or both of the top and bottom outer layers being patterned to include a portion of the buffer cavities on either side of the resonant cavity; and

a piezoelectric thin-film sensor formed on one of the outer layers and a port acoustically coupling the sensor to the resonant cavity.

10. The integrated photoacoustic spectroscopy cell according to claim 9, including gas inlet and outlet ports formed through one or both of the outer layers and into the buffer cavities.

11. The integrated photoacoustic spectroscopy cell according to claim 9, wherein the layers are silicon wafers.

12. A method of fabricating a photoacoustic spectroscopy cell, comprising the steps of:

forming a resonant cavity in an inner substrate;

joining the inner substrate to a pair of outer substrates, thereby encapsulating the resonant cavity; and

acoustically coupling a microphone to the resonant cavity.

13. The method of claim 12, further including the step of forming buffer cavities in the inner substrate on either side of the resonant cavity.

14. The method of claim 13, further including the step of forming buffer cavities in one or both of the outer layers in alignment with the buffer cavities formed in the inner substrate.

15. The method of claim 13, further including the step of forming gas inlet and outlet ports through one or both of the outer layers and into the buffer cavities.

16. The method of claim 12, wherein the step of acoustically coupling a microphone to the resonant cavity includes the steps of:

depositing a piezoelectric thin film onto one of the outer substrates;

patterning the thin film to create an acoustic sensor; and

forming a port from the acoustic sensor into the resonant cavity.

17. The method of claim 16, wherein the piezoelectric thin film is lead zirconate titanate (PZT).

18. The method of claim 16, wherein the piezoelectric thin film is aluminum nitride (AlN).

19. The method of claim 16, wherein the piezoelectric thin film is zinc oxide (ZnO).

20. The method of claim 16, wherein the substrates are silicon substrates.

21. The method of claim 19, wherein the step of joining the inner substrate to a pair of outer substrates includes the use of temperature and pressure to create a gold-silicon eutectic bond.

22. The method of claim 19, wherein the step of joining the inner substrate to a pair of outer substrates includes the use of temperature and pressure to create a gold-tin eutectic bond.